TYPICAL VIRGIN STAND OF DOUGLAS FIR, CEDAR, AND AMABILIS FIR IN THE OLYMPIC NATIONAL FOREST.

Some of the Douglas firs and cedars are 80 inches in diameter.

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HENRY S. GRAVES, Forester.

THE OLYMPIC NATIONAL FOREST:

ITS RESOURCES AND THEIR MANAGEMENT.

BY

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Forest Service,
Washington, D. C., February 15, 1911.

Sir: I have the honor to transmit herewith a manuscript entitled "The Olympic National Forest: Its Resources and Their Management," by Findley Burns, Chief of Publication, Forest Service, and to recommend its publication as Bulletin 89 of the Forest Service.

Respectfully,

Henry S. Graves,
Forester.

Hon. James Wilson,
Secretary of Agriculture.

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THE OLYMPIC NATIONAL FOREST.

Area, 1,594,000 acres. Headquarters, Olympia, Wash.

RESOURCES OF THE OLYMPIC MAINLY UNDEVELOPED.

The Olympic National Forest contains one of the heaviest stands of timber in the United States. The merchantable stand within its boundaries approximates 25,500,000,000 board feet, and the Forest is capable of producing a sustained annual yield of 250,000,000 board feet. It lies in a region of exceptionally heavy rainfall and one peculiarly suited to the production of timber. No extensive agricultural region lies near it, and while it contains some mountain meadows, present conditions are almost prohibitive of stock raising. The Forest was created to establish a timber reserve which could be drawn upon for a permanent supply when the immense stands now upon private holdings have been cut away. Its greatest usefulness, therefore, lies in the future. At present irrigation is not practiced extensively in the vicinity, and power development has not yet been undertaken on a large scale. Without the heavy forest cover to check the swift run-off of the enormous winter rainfall, cultivated lands on the Olympic Peninsula would be likely to suffer serious damage. Extensive water powers await development, and the dense cover upon the watersheds within the Olympic will, when development begins, be of the utmost importance in preventing alterations in the character of the streamflow.

The force upon the Forest, besides the supervisor and deputy supervisor, includes 5 district rangers, 5 station rangers, 2 technical assistants, 2 scalers, and 12 guards.

TOPOGRAPHY AND DRAINAGE OF THE FOREST.

The Forest lies within the Olympic Peninsula and covers portions of Clallam, Jefferson, Chehalis, and Mason Counties. It comprises the Olympic mountain group, with its relatively abrupt slopes upon the east, north, and south, and its long slope to the west. The Olympics are a group of mountains of nearly circular shape, radiating from a central mass which culminates in Mount Olympus, with an altitude of 8,150 feet. Many other summits rise to altitudes ranging between 7,000 and 8,000 feet, and large areas lie above timber line, which here has an altitude of from 5,500 to 6,000 feet. Near timber line are considerable areas of open country, some covered with ice, others barren

and rocky, while some consist of open grass lands. Glaciers and snow fields are numerous in the central mountains. Though individually of small extent, collectively they cover a large area. As a whole, the region is wild, rugged, and inaccessible. The eastern and northern portions of the Forest are exceptionally rough and broken. The mountains are high, the stream courses run north, south, east, and west, and the timber, except on the lower levels and along the courses of streams, is at present of relatively little commercial value. On the western and southern portions the mountains are lower and somewhat less rugged, and the whole is covered with an almost continuous forest of the finest timber.

The Forest is drained by many rivers, which head in or near the central mass and radiate outward toward the four points of the compass. The streams flowing to the east empty into Hood Canal, and are short, with steep descents. Chief of these are the Quilcene, Dusewallips, Duckabush, Hamahama, and Skokomish. To the south flow the Humptulips, Wynootche, and Satsop. To the north, into the Strait of Juan de Fuca, flow the Dungeness and Elwha, while to the west the Quillayute, with its branches, the Dickey, Soleduck, Bogachiel, and Kalawa, and the Hoh River, Queets River, and the Queniult flow directly into the Pacific Ocean.

LAND CLASSIFICATION.

According to the best data at hand, the 1,594,000 acres within the Forest may be classified as follows:

Classification.	Acres.	Per cent.
Merchantable timber[1]	854,000	53.58
Second growth[2]	47,000	2.95
Barren land or land incapable of producing timber	542,000	34.01
Burns, new or not restocking	42,000	2.63
Alienated land	109,000	6.83
Total	1,594,000	100.00

[1] Under this is included much timber that is immature, but has merchantable value.
[2] Includes 570 acres of cut-over land.

WATER AND AGRICULTURE.

TEMPERATURE AND RAINFALL.

The climate of the region is controlled by the prevailing westerly winds from the Pacific Ocean, and is characterized by great uniformity of temperature and by an exceedingly heavy rainfall, probably the heaviest in the United States.

On the west side of the Forest the annual rainfall amounts to from 100 to 150 inches, and on the east side to from 50 to 100 inches. By far the greater part of this precipitation comes between the 1st

of November and the 1st of May. In consequence the flow of streams during the winter is exceptionally heavy, with intermittent floods. In summer, on the other hand, the flow is likely to be very low, and many streams which do not head in the high mountains practically go dry. At present Port Angeles and Port Townsend are the only cities which rely upon the Forest for their water.

AGRICULTURAL DEVELOPMENT OF THE OLYMPIC PENINSULA.

Though the winters bring a great amount of precipitation, the summers in the regions surrounding the Forest are almost arid. In some places irrigation is necessary for the successful growing of crops. Land on the Dungeness River, near Squim, is now irrigated with water from the Forest. Another element affecting the possible agricultural development of the Olympic Peninsula is the cost of clearing land. Almost the whole of the peninsula is heavily forested, and the cost of clearing the land for crops amounts to from $50 to $200 per acre, a practically prohibitive charge under present market conditions. To what a small extent agriculture is practiced in the neighborhood of the Forest is shown by the following table, which gives the land classification for Chehalis, Clallam, Jefferson, and Mason Counties, taken chiefly from the assessment rolls of the State Board of Equalization (1909).

TABLE 1.—*Land classification of Chehalis, Clallam, Jefferson, and Mason Counties, Wash.*

County.	Total area.	National forests.	Private timberland.	State lands.	Unimproved land, cutover and burned.	Improved land.
Chehalis	1,259,520	173,680	556,755	67,356	247,674	11,189
Clallam	1,156,480	520,540	300,802	74,279	204,507	12,054
Jefferson	1,129,600	737,060	195,259	73,290	63,736	4,738
Mason	635,520	163,280	241,813	42,655	150,825	7,606
Total	4,181,120	1,594,560	1,294,629	257,580	666,742	35,587

Included in the four counties are also 225,500 acres of Indian and military reservations and 107,522 acres of town and city lots, etc.

The State lands, which are largely timber lands, added to the privately owned lands, make a total of 1,552,209 acres, or an area nearly equal to that of the Forest, but possessing far better soil, which is not put to agricultural use because of the superior value of the timber. The 600,000 acres of logged and burned lands, all much better situated and more suitable for farming than the lands within the Forest, have never been put to agricultural use.

Of the entire area of over 2,300,000 acres available for agricultural development in the four counties only 35,000 acres, or 1.5 per cent, is

being cultivated. Further indication that the region is not at present primarily suited to agriculture is given by the result of an elimination made from the Forest about 10 years ago. In all, 720,000 acres of the lowlands on the north, west, and south sides of the Forest were opened to settlement on the ground that the land was more valuable for agriculture than for timber. At present, outside the naturally timberless areas, not more than 600 of the 720,000 acres is under cultivation, and the population on this vast tract does not exceed 50 settlers, which is less than the number of those who have homesteaded and are living on agricultural land within the Forest under the provisions of the act of June 11, 1906.

Lumbering is the one great industry of the region and will so remain for many years. Agriculture may in time come to be of real importance, but there is little prospect of early or rapid development. It is worth noting that of all the lands cut and burned over in the State of Washington west of the Cascades not more than 10 per cent have been put to cultivation.

While at present, then, the water from the Forest is needed for irrigation or domestic purposes only to a very small extent, it will be available and necessary for future agricultural development. By far the chief purpose which the Forest has to serve, however, is that of a source of timber supply.

WATER POWER.

Many of the streams which head in the Forest have great possibilities for power development, though a serious drawback to extensive utilization is the relative scarcity of summer flow. Soleduck River and Lake Crescent, and the Elwha, Skokomish, Hoh, Queets, Wynoochee, Clearwater, Kalawa, Bogachiel, and Queniult Rivers have a volume of water which holds out possibilities for the operation of commercial power plants. Many smaller streams, such as the Dungeness, Quilcene, Dusewallips, and Duckabush, show possibilities for development to supply local needs. Up to the present it has not been possible to estimate accurately the amount of water power within the Forest capable of development. From the enormous flow carried by some of the larger streams, and their rapid descent, however, it must be very great. The nearness of the Forest to the manufacturing cities of Puget Sound and Grays Harbor gives to the available power sites an added value.

A large commercial plant is now under construction on the Elwha River, just north of the Forest boundary. With the construction of railroads on the west side of the peninsula, and the consequent opening of that portion of the region, the streams which flow west from the Forest will probably be utilized for power purposes. Until then, however, no development there is possible.

TIMBER.

The best estimates so far made show that the 25,500,000,000 feet of merchantable timber on the Forest is made up of Douglas fir, 9,435,000,000 feet, or 37 per cent; western hemlock, 8,925,000,000 feet, or 35 per cent; amabilis and grand fir, 3,825,000,000 feet, or 15 per cent; Sitka spruce, 2,040,000,000 feet, or 8 per cent; and western red and Alaska cedar, 1,275,000,000 feet, or 5 per cent. Of the 854,050 acres which it covers, 846,320 acres bear stands from 200 to 500 years old; 5,800 acres bear stands from 120 to 200 years old; 450 acres bear stands from 80 to 120 years old; and 1,480 acres bear stands from 60 to 80 years old.

Roughly, the timber on the Forest can first be divided into two main types—the east slope and the west slope. The difference between the stands of timber on these two types is due chiefly to difference in soil and climate. On the west side of the Forest the precipitation amounts to from 100 to 150 inches a year, fogs are frequent, summers cool, and the soil of a good quality for the production of timber. Precipitation on the east side amounts to from 50 to 100 inches a year, fogs are less frequent, the summers hotter, with consequent evaporation, the soil of poorer quality, and the whole country rougher and less suited to timber growth. As a result, approximately 80 per cent of the merchantable timber on the Forest is situated on the west slope.

With these two main types in mind, the forest may further be divided into three silvicultural types: (1) The coastal plain type, (2) the foothill or lower type, and (3) the upper slope or subalpine type.

The coastal plain type, which runs from the coast to an altitude of about 500 feet, enters the Forest only in a few places on the west and south sides, and within the boundaries covers probably not more than 30,000 acres. The soil is either a pure or a gravelly clay, and is very retentive of moisture. The type lies well within the fog belt and is peculiarly free from fire. As a result of this freedom from fire there is comparatively little Douglas fir in the stand, which is made up chiefly of hemlock, spruce, and cedar. On this type cedar often, and occasionally hemlock and spruce, grow in pure stands. Elsewhere on the type the three species are mixed in almost every proportion. The stand per acre is the heaviest on the Forest, running from 50,000 to 100,000 board feet, while the annual production per acre amounts to from 500 to 1,000 board feet. Sitka spruce here reaches its best development, ranging in height from 250 to 300 feet, and in diameter from 6 to 15 feet. Where this type enters the southern portion of the Forest, Douglas fir is more plentiful and reaches probably its best development, from 250 to 300 feet high and from 4 to 8 feet and more in diameter.

The foothill or lower slope type occupies about 60 per cent of the timbered area, or about 565,000 acres. On the west slope it differs

from the coastal plain in having a better drained soil, made up of decomposed rock, generally deep, and almost as favorable to tree growth as the clay soil of the first type. In most places it runs from the boundary of the Forest back to the main mountains, reaching an altitude of about 2,000 feet. Its productiveness on the west slope almost equals that of the coastal plain, running from 400 to 800 board feet per acre per annum. Douglas fir is the chief tree, though the type contains also large amounts of hemlock and amabilis fir, with comparatively little cedar. Douglas fir here does not reach quite the development that it does on the coastal plain type, but hemlock and amabilis fir reach their best, especially on north slopes. Amabilis fir reaches a diameter of from 2 to 4 feet and a height of 200 feet, with a perfectly straight stem and a clear length of from 75 to 100 feet. Hemlock reaches about the same diameter and height.

The foothill type on the east and north sides of the Forest displays much the same topography, but its soil is coarser, with more rock and gravel, which, with the lesser precipitation and warmer summers, greatly lessens its value for timber. The Forest is one of almost pure Douglas fir. There is hemlock, of course, and on river bottoms and other moist soils a considerable amount of cedar, but on the whole the natural conditions are favorable to Douglas fir above all other species. On the steeper slopes the soil is thin, rocky, and dry, and the Forest is made up of almost pure stands of Douglas fir of poor quality, with a slight mixture of hemlock and western white pine. The higher slopes of the foothill type are exceedingly steep and rocky, and bear stands of unmerchantable Douglas fir, with a slight mixture of western white pine. The gentle slopes lower down, and occasional basins, often bear pure stands of cedar, which here reaches its best development, with diameters from 4 to 8 feet and a height of 200 feet. Often the stands run from 50,000 to 100,000 board feet per acre.

The timber of the upper slope type, at present entirely inaccessible, consists of the same species found on the lower types, with the addition of Alaska cedar. The stand is dense, but the trees are smaller and of poor quality. Should mining develop at the higher altitudes on the Forest, this type will probably find its chief use in the future in supplying the necessary timber. In any event, it will probably attain commercial value in approximately 50 years. This type occupies approximately 347,000 acres, or 37 per cent of the merchantable timbered area.

Taking the Forest as a whole, the entire region can be said to be one particularly suited to the production of Douglas fir, with the certainty of a large percentage of hemlock in mixture. Wherever fire has run over the ground in the past, Douglas fir is to-day the dominant tree. The only situations where Douglas fir is absent or

forms but a small percentage of the stand are those which have always been practically free from fire. The entire western and southern portions of the Forest, where exist the best conditions for the production of timber and the heaviest stand, are, with the almost negligible exception of swamps and river bottoms, suitable for the production of Douglas fir. Owing to the freedom of this portion of the Forest from fire, however, the species at present occupies only the drier slopes. Even under present conditions it is found scattered here and there over the whole area, though in many places it is absent. Hemlock is everywhere in the western and southern portions of the Forest, as it is in the eastern and northern, and often in pure stands. Extensive stands of pure hemlock are common on the west side. Spruce grows upon the moister soils at low altitudes, and cedar is found in moist situations throughout the Forest where fire has not run.

The eastern and northern portions of the Forest, with their drier climate, poorer soil, and frequent fires in the past, show, as might be expected, uniform distribution of Douglas fir with its companion species, hemlock. Cedar has retained its hold on the moist situation protected from fire, but spruce is practically absent. Grand fir is found with cedar in some of the bottoms, but its distribution is very irregular. Amabilis fir is confined almost entirely to the western and southern portions of the Forest.

From the standpoint of management there are only two types: (1) The steep, dry slopes upon the northern and eastern portions, extending back to the main divide, together with the upper slopes near the timber line over the entire Forest; and (2) all of the coastal plain, foothills, and lower slopes. The first type contains about 10 per cent of the entire stand, the second about 90.

In the first type the timber runs from 5,000 to 20,000 feet per acre, is of poor quality, and is often scattered. At present it is almost wholly inaccessible, and though covering a large area contains but a small percentage of the merchantable stand. It will probably not be reached before 50 years hence, when it will be cut for ties, cordwood, posts, and mine timbers. Since the soil is thin and poor its productiveness is low, and an artificial system of regeneration after cutting would probably not be practicable. It is thought that here the selection system would, for a time at least, give the best results. Under this system natural reproduction will come in slowly, and the new crop will be a mixture of white pine, hemlock, and Douglas fir. No sales have ever been made on this type, but in those made in the future white pine, which occurs in sufficient quantity to justify an attempt to increase its proportion in the stand, will, in all probability, be favored in the second crop, since it is a more vauable tree than Douglas fir and has almost as rapid a growth.

On the second type, on the east and north sides of the Forest, with their almost pure stands of Douglas fir, the timber will have to be cut clean. From present experience it seems probable that natural reproduction can be obtained on cut-over areas within from 5 to 10 years if the slash is burned. Douglas fir will be favored, and cutting will proceed slowly enough to allow adjoining areas of that timber to reseed the ground. The resultant stand, on the drier soils at least, will be practically pure Douglas fir. On subirrigated soils at the foot of the slopes hemlock, cedar, and grand fir will find a foothold and conditions favorable to their development. On the better soils of the slopes it will probably pay to do a certain amount of direct seeding of Douglas fir. One sale of 5,600,000 board feet has been made in this type on the east side of the Forest. The timber sold was on the Duckabush River, in a strip a mile long and a quarter of a mile wide, crossing the river at right angles. The stand consisted of Douglas fir 75 per cent, hemlock 5 per cent, and cedar 20 per cent. The terms of the sale called for clear cutting of all the timber. Cutting began in 1907, and the last timber was removed in August, 1910. It is planned to burn the cut-over area this fall (1910). The ground is expected to reseed naturally, from the sides and above, with a stand of Douglas fir on the upper slopes and cedar on the bottoms. Experimental planting with both seeds and seedlings will be undertaken on small plats on the cut-over area.

On the west and south sides of the Forest the conditions on the second type are somewhat different from those on the same type on the east and north sides. Here the Forest is exceedingly dense and the ground is covered with a deep accumulation of humus, rotten wood, leaves, etc. Immunity from fire has resulted in the absence of Douglas fir in many places, and hemlock forms a large proportion of the stand. As on the eastern portion of the type, clear cutting seems essential to proper management. To cut merely the 10 or 20 enormous trees on every acre, under present logging conditions and with the extreme density of the stand, would certainly result in great destruction to the other growth. Moreover, Douglas fir, spruce, and cedar must reach the mineral soil in order to take root, and a second crop composed of any of these species would not be possible if the heavy humus remained unburned. It would, of course, under the selection system, be possible to get a stand of hemlock, since a great many trees of this species, from 15 to 20 inches in diameter, would be left on the ground after the larger trees had been taken out. In that case, however, the fire danger from the heavy ground litter would be exceedingly great. Moreover, hemlock is not the equal of the other species commercially, and is more expensive to log. The only solution of the problem, therefore, lies in clean cutting, with subsequent burning of the ground litter. The problem, however,

does not end here, for it will not be possible to secure natural reproduction with Douglas fir as on the east side of the Forest, where that species already covers the ground. Artificial restocking must be resorted to if brush is not to cover the ground for from 10 to 20 years after the present forest is cut away, for this is the invariable rule on all logged areas in the region.

The artificial sowing of cut-over areas, moreover, will in almost every case be cheaper than securing a new crop of timber by natural means. Assuming that the latter system was to be put into effect, it would be necessary to leave an average of two seed trees per acre. It is more than likely that the great majority of these would be blown down before the area was fully reseeded. Practically none would be left by the time that restocking was complete. Assuming that each seed tree contained 3,000 board feet of timber, a very conservative estimate, this would mean that 6,000 feet of timber per acre would be lost. At a price of $2.50 per thousand, the loss in money per acre would amount to $15. Direct seeding, on the other hand, costs not more than $5 per acre, while if it was necessary to plant seedlings the cost would not amount to more than $6 per acre. In any event, therefore, the saving in cost by securing a new crop by artificial instead of natural regeneration would amount to from $9 to $10 or more per acre.

Two timber sales have been made on this portion of the type. One, on the east fork of the Humptulips, was of 30,000,000 board feet, made up of Douglas fir, 16,000,000 feet; hemlock, 12,000,000 feet; cedar, 1,000,000 feet; spruce, 1,000,000 feet, and covering 1,000 acres. The other sale was on the west fork of the same river. It disposed of 2,000,000 board feet, made up of spruce, 800,000 feet; hemlock, 500,000 feet; cedar, 400,000 feet; Douglas fir, 200,000 feet; and amabilis fir, 100,000 feet, covering in all 60 acres. Under the terms of both sales the land is to be cut clean. After this is done, everything remaining on the ground will be burned. This will include the smaller hemlock, amounting to about 5,000 feet per acre, for which there is no market and which is very expensive to log. The cut-over areas, when burned, will be reproduced to Douglas fir, with spruce upon the bottoms. The planting will be for experimental as well as for practical purposes, and both seed and seedlings will be used to determine which is best suited to conditions on the Forest. Cedar, it is expected, will come in on moist situations without recourse to artificial regeneration.

In general, the silvicultural aim on this type throughout the Forest will be to favor Douglas fir on the drier situations, and on moist soils and river bottoms, spruce and cedar. Hemlock will be kept out wherever possible, but it is inevitable that it will come in, to some extent at least, even on the burned areas.

The sustained annual yield which the Forest is capable of producing amounts to approximately 250,000,000 board feet. This amount is not being cut from the Forest at present, because conditions in the region do not warrant it. To-day, outside of the small amount used locally, the timber cut and manufactured in Washington goes to the Rocky Mountain, Middle, and Eastern States by rail shipment and by water to southern California and all parts of the world. Under present conditions it is impossible for the lumbermen of the Northwest coast to ship their timber of lower grade beyond the "40-cent zone," that is, the territory within which the freight rate on timber is 40 cents or less per hundred pounds weight, and sell it with profit in competition with southern pine. This "40-cent zone" extends little farther east than Denver, and, in consequence, the territory in which the lumbermen of the Northwest can dispose of their lower-grade timber is an exceedingly restricted one. Rates on cargo shipments to Europe and the Orient vary from $10 to $20 per 1,000 board feet Under present logging practice, small logs less than 15 inches in diameter contain such a large percentage of second-grade material that it rarely pays to lumber them. As a result a vast amount of material which could be sold if the price was higher or the freight rate lower is entirely wasted. More timber is left on the ground after logging in western Washington than constitutes the virgin stand in the Lake States and the pineries of the South.

While practically all of the timber on the Forest is mature, on the whole it is not decreasing in either quality or value. The older Douglas fir in many places is gradually dropping out, but the loss from this source is made up by growth in the other species. Hemlock, the growth of which will largely balance the loss from Douglas fir, while not now as valuable as the other species, will in all probability approach it in value in the future. To cut large amounts of timber from the Forest at the present time, therefore, would entail a very great and needless waste, only to place material upon a market already glutted. The timber on a National Forest such as the Olympic, situated in a heavily forested region, is meant primarily as an asset from which the future supply can be drawn. This does not mean that all present legitimate demands upon its timber resources will not be supplied promptly, or that cutting will not be carried on with a view to improving the quality of the Forest and maintaining its productiveness. The full utilization of its timber resources will merely be postponed to such time as it can be done consistently with the purposes for which the Forest was created.

A large portion of the timber on the Forest, moreover, is at present inaccessible. No part of the stand on the western portion, amounting to approximately 67 per cent of the total, can be logged until a railroad is constructed along that side of the peninsula. Several surveys

FIG. 1.—DOWN TIMBER ON THE OLYMPIC NATIONAL FOREST.

Often it is impossible to travel more than a quarter of a mile an hour through such country, and trail building is rendered very expensive.

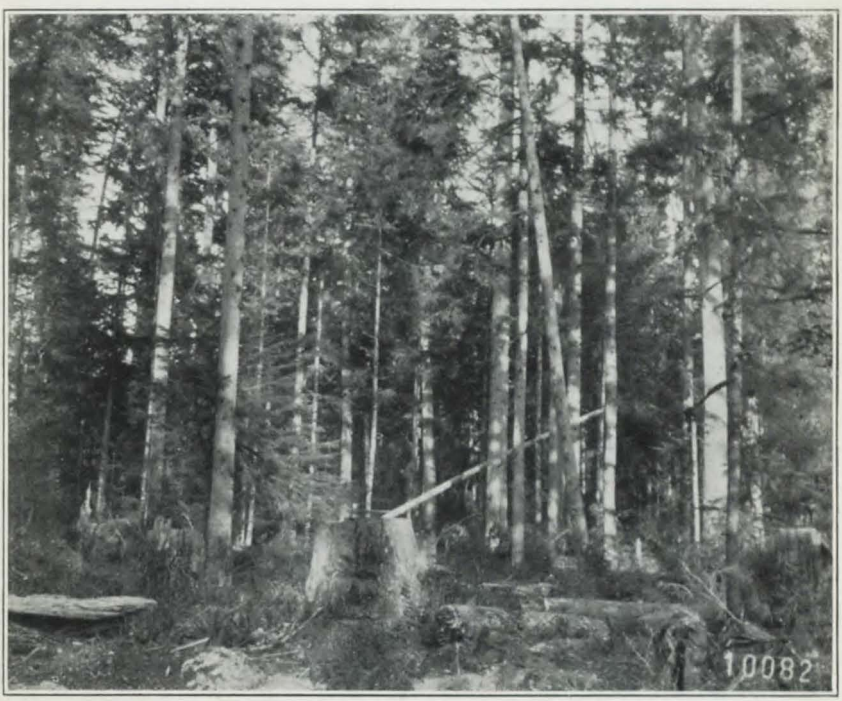

FIG. 2.—STAND OF TIMBER LEFT AFTER LOGGING IN THE VICINITY OF THE OLYMPIC NATIONAL FOREST.

Only the largest trees of the most valuable species are at present taken by the lumbermen.

by different railroads (Chicago, Milwaukee & Puget Sound; Oregon & Washington; and Northern Pacific) have already been made, and it is possible that a line will be built in the near future. No definite announcement, however, has been made.

Plans already made for logging on the Forest for the next 10 years contemplate a cut during that period of 300,000,000 board feet, the timber to be cut chiefly along the Hood Canal and the east and west forks of the Humptulips River. Prices obtained for timber in the two sales made recently were: Fir, cedar, and spruce, $2.50 per 1,000 board feet, and hemlock, $1.25. At an average price of $2.50 per 1,000 the income from the Forest for the next 10 years will, therefore, amount to $750,000, or $75,000 a year. This will mean a yearly income to the four counties in which the Forest lies of $18,750 under the law which provides that one-fourth of all National Forest receipts shall be paid over to the States for schools and roads.

BURNS.

On different parts of the Forest, particularly on the northern and eastern portions, are a number of old burns which are restocking with a second growth, chiefly of Douglas fir. Their total area amounts to 46,370 acres, of which 29,580 acres is covered with a new growth from 1 to 20 years old, 10,360 acres with a growth from 20 to 40 years old, and 6,430 acres with a growth from 40 to 60 years old. Of new burns or burns not yet restocking there is a total of 41,950 acres. Of this approximately 10,000 are included in a new burn (1907) on the Soleduck River. Seven hundred acres of this were planted experimentally in 1909, and further planting will be undertaken from year to year. While all burns in the region will reseed naturally in the course of time, the period which it takes for a full restocking, if the burned-over area is left to itself, amounts to from 10 to 50 or 100 years, depending upon the situation of the burn. Planting, therefore, is necessary if new growth is to come in quickly.

GRAZING.

Stock raising is not an industry of the region surrounding the Forest. With no public range, and with hay at from $20 to $30 per ton and grain up to $40 per ton, stock raising for the market is impossible. Dairying is the chief agricultural industry, and outside of a certain number of stock cattle raised in connection with it practically all the cattle on the peninsula are used for dairying purposes.

The Forest offers range for stock in the bottoms, in portions of the timber, and in the mountain meadows above timber line. The mountain meadows could be grazed for only two or three months in the

year and are at present inaccessible to stock through lack of passable trails and scarcity of food along the route by which they would have to be driven up. Moreover, it is likely that the State will establish a game preserve in the higher mountains, which will make their use for stock inadvisable. Permits for only 36 head of cattle to graze upon the Forest were issued in 1909.

MINING.

Though there is practically no mineral development on the Forest at present, some prospects of both gold and copper have been discovered. Owing to the geological formation the better ores lie at the higher altitudes. In April, 1909, the Olympic National Monument, covering about 27 townships in the central portion of the Forest, was established by presidential proclamation. This includes the wild region of glaciers and rugged peaks around Mount Olympus and contains some of the grandest scenery in the United States. It contains also the summer range of the Olympic or Roosevelt elk, which has been exterminated throughout other portions of its former range. The establishment of the monument closed the area which it covered to mineral development, since under the law it is impossible to take up a mining claim within the boundaries of a national monument. To do away with this restriction and at the same time to provide against destruction of the elk, it has been proposed to establish a State game preserve in place of the monument, and so permit full use of its mineral resources.

SETTLEMENT.

The region within the Forest is so rough, heavily timbered, and inaccessible that it offers little opportunity for agriculture. The soil, moreover, is not suitable for the raising of most crops except on the river bottoms, which are very narrow and subject to floods, so that agriculture on them is exceedingly precarious. Under the act of June 11, 1906, which empowers the Secretary of Agriculture to recommend for listing under the homestead laws such lands within the Forest boundary as are in his opinion more valuable for agriculture than for the production of timber, 63 claims with a total area of 5,983 acres have been taken up.

Outside of the bottoms, the only land within the Forest which might at first sight seem valuable for agriculture are the comparatively level areas lying in the extreme western portion and forming a part of the coastal plateau, with an altitude of about 500 feet, amounting in all to about 30,000 acres. The greater part of this, with the exception of some burned areas, is covered with the finest timber, and to make the land suitable for agriculture would require

an expenditure of about $100 to $200 per acre. The soil is mostly a red gravelly loam, with a rather large content of silt, but one which will wear out within a few years unless heavily fertilized. The enormous precipitation, together with the heavy run-off from the slopes directly to the east, the level character of the land, and the lack of drainage will result in frequent inundation and make an artificial drainage system necessary if the land is to have permanent value for agriculture. This will cost at least $25 per acre. In addition it is difficult to ripen and harvest any grain except oats. Distance from market and the fact that the roads are impassable for teams during a greater part of the year would make it extremely difficult for the rancher to sell his crops in any but small quantities.

Even the burned areas, owing to the number and size of the stumps and snags, will require an expenditure of from $50 to $100 per acre even partially to clear, while a thorough job will cost at least $200 per acre. Moreover, there is from 10,000 to 20,000 board feet of merchantable cedar per acre which escaped the flames, and which even to-day has a value of $2 a thousand, while in 5 or 10 years, with the coming of a railroad, its value will increase to at least $4. Reproduction is in the main satisfactory, and under forest management the land is capable of producing 800 board feet per year. With an assumed stumpage value in 40 years time of $10 per thousand, this would give a gross annual income of $8 per acre and a net income of not less than $7. The present value of the land for the production of timber is, therefore, close to $100 per acre.

PERMANENT IMPROVEMENTS.

As the accompanying map shows, the Forest is as yet very poorly provided with roads, trails, and other necessary improvements. To guard against fire and render the region accessible there is needed a complete system of trails over the entire Forest. The cost of building trails on the Olympic, as on the Forests on the west slope of the Cascades, is excessive, ranging from $200 to $500 a mile, in comparison with a cost of from $20 to $50 a mile in the Rocky Mountains. This high cost is due primarily to the great amount and size of the down timber which almost everywhere covers the ground, and which it is impossible to remove except with dynamite. To saw one of these giant trunks apart for the passage of a trail, the only method practicable, takes a man an entire day. Merely to clear the trails of fallen timber in the spring on a Forest such as the Olympic costs as much as originally to construct trails of similar length in the Rocky Mountains, where the timber is open and little grading is necessary.

Because of the high cost of trail building on the Olympic, the amount of actual construction work which has been possible with its

pro rata share of the fund is small in comparison with the work done on other Forests, where conditions are more favorable. At present the Forest is equipped with 160 miles of trail, 18 miles of road, 15 miles of telephone line, and 11 cabins. While practically all of the roads, telephone lines, and cabins have been built by the Forest Service, many miles of trail were already in existence before the creation of the Forest.

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R.16W. R.15W. R.14W. R.13W. R.12W. R.11W. R.10W. R.9W. R.8W. R.7W. R.6W. R.5W. R.4W. R.3W. R.2W.

T.33N. T.32N. T.31N. T.30N. T.29N. T.28N. T.27N. T.26N. T.25N. T.24N. T.23N. T.22N. T.21N.

NEAH BAY IND. RES.

JUAN DE FUCA STRAIT

PACIFIC OCEAN

QUEENIULT IND. RES.

Suez · Sekiu River · Elk Lake · Royal P.O. · Ozette · Ozette R. · Ozette Lake · Crooked Cr. · Lake Dickey · Dickey · Swan · Beaver Lake · Sappho · Lake Pleasant · Beaver · Pyes · Shuwah · West Fork Dickey River · East Fork Dickey River · Dickey River · Quillayute River · Boston · Lapush · Soleduck River · Bogachiel River · Calawah River · West Fork Calawah River · Middle Fork Calawah River · East Fork Calawah River · Jackson Creek · Bench · Pins · Hoh River · Clearwater River · Christmas Cr. · Clearwater · Queets R.S. · Evergreen P.O. · Mathany Creek · Queets River · Sams Creek · Salmon Creek · Queniult Lake · Queniult River · Humptulips River · St. Helens Creek · Wynoochee River · Satsop River · Wishkah River · Wynoochee Lake · Duck Lake · Bench · Brown Creek · Bench · Bench · Bench · Hoodsport · Potlatch · Cushman L. · Mt. Ellinor · Copper Mt. · Mt. Rose · Mt. Church · Mt. Tebo · Mt. Skokomish · Mt. Agnes · Mt. Tom · Mt. Stone · Mt. Anderson · Lakes Martha and Mary · Elwha River · Goodstein Cr. · Mt. Olympus · Glacier Creek · Goldie Creek · Mt. Carrie · Hoh River · Boundary Line · Lost Creek · Lillian Creek · Long Creek · Cedar Creek · Skokomish River · Mt. Storm King · Piedmont P.O. · Lyre River · Lunamellon Indian R. · Crescent · Barnes Creek · Boulder · Soleduck River · North Fork Soleduck River · Mt. Angeles · Little River · Ennis Cr. · Lake Creek · McDonald Creek · Canyon Creek · Elwha River · Boston · Junction · Lelam · Little Quilcene R. · North Fork · Big Quilcene River · South Fork · Quilcene · Rocky Fork · Mt. Constance · Dosewallips River · South Fork · The Brothers · Duckabush River · Hamahama River · South Fork · Box Canyon · Camp Six Stream · North Fork Skokomish River · Jefferson Co. · Mason Co. · Chehalis Co. · Clallam Co. · Jefferson Co.

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